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BLACK BRANT VA PAYLOADS FOR PCA-69

W. Eisenschmit

Fairchild Hiller Corporation

Prepared for:

Air Force Cambridge Research Laboratories

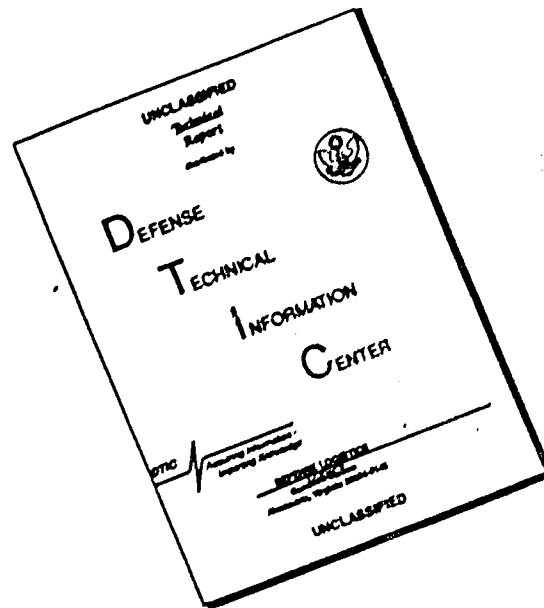
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AD 759851

Submitted By

Fairchild Hiller Corporation
Technical Services Division
6501 Lafayette Avenue
Riverdale, Maryland 20840



FINAL REPORT

BLACK BRANT VA PAYLOADS
FOR PCA-69

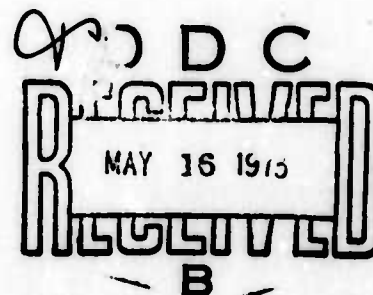
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13. ABSTRACT The formal scientific investigative program for studying the Polar Cap Absorption phenomenon, PCA-69, culminated with the occurrence of a major solar event which began on 2 November 1969. Scientific data were collected via 36 specially instrumented sounding rocket payloads launched during the event. Of these, six payloads, flown on Black Brant VA rockets, were provided by the Fairchild Hiller Corp. The specific requirements of these payloads, and their capabilities are discussed in this report.			
KEYWORDS: Black Brant VA Payloads, PCA-69			

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I. INTRODUCTION

The formal scientific investigative program for studying the Polar Cap Absorption phenomenon, PCA-69, culminated with the occurrence of a major solar event which began on 2 November 1968. Scientific data were collected via 36 specially instrumented sounding rocket payloads launched during the event. Of these, six payloads, flown on Black Brant VA rockets, were provided by the Fairchild Hiller Corporation. The specific requirements of these payloads, and their capabilities are discussed in this report.

II. DESIGN CONSIDERATIONS

The Black Brant VA payloads were required to measure protons, alpha particles, electron and ion density and temperatures, light emissions, X-rays and Lyman Alpha in the "D" region of the ionosphere at various times during the solar event. Fairchild Hiller thus integrated the appropriate instruments and deployment systems into operational payloads for acquiring and transmitting data back to earth. Previously proven acquisition techniques were employed wherever possible.

In addition to the requirements of instrumentation, considerations of vehicle compatibility, serviceability, and extreme launch environment were factored into the payload design.

When the site of the "PCA 68" program was moved from Thule, Greenland to Fort Churchill, Manitoba, and renamed "PCA 69", several design changes were required to permit measurements of additional atmospheric parameters. As a result, three distinct payload configurations were established--each one permitting the measurement of slightly different parameters. In addition, the tracking technique to be used was changed from Tone Ranging to Radar. This necessitated the incorporation of a beacon.

To permit maximum data coverage in the altitude range of interest, i.e., in the 70 to 125 KM region, the rocket altitude performance had to be degraded by addition of ballast. This resulted in a payload which was about 600 lbs in weight, the heaviest payload ever to be launched on a Black Brant vehicle, thus altering nominal payload design loads criteria. Certain instruments and sensors required uninhibited forward viewing from the payload. This necessitated the use of ejectable doors and deployable mechanisms.

Also to be considered were possible Radio Frequency Interferences. These could originate with the tracking radar, on-board telemetry transmitters, other vehicles launched simultaneously and ground based propagation experiments. Adequate shielding and/or isolation was thus required in the payload designs.

III. PAYLOAD DESCRIPTION

All the Black Brant selected payloads were similar in size and shape. Two cylindrical cans contained batteries, telemetry and control components and wiring. These comprised the lower portion of the payload. The section housing the scientific payload was a cone cylinder containing four ejectable doors. The sensors exposed by, or deployed through the door openings were either shelf mounted, drawer mounted or boom mounted. The drawer mounted instruments were deployed approximately eight inches to provide an unobstructed forward field of view. The boom mounted instruments were deployed approximately 38 inches. A long spike was attached to the nose and was insulated from the main payload. This was utilized as an antenna for the ZO probe.

Aspect data was provided by a three axes gyro contained in the telemetry section and a single axis magnetometer located in the instrument section.

Telemetry and beacon antennas were spaced around the telemetry section which also contained two umbilical connectors for control and monitoring of the entire payload.

Timed functions were controlled by redundant "G" actuated timers. These functions were ejection of doors and deployment of booms and were adjusted to occur between T+45 to 50 seconds after launch.

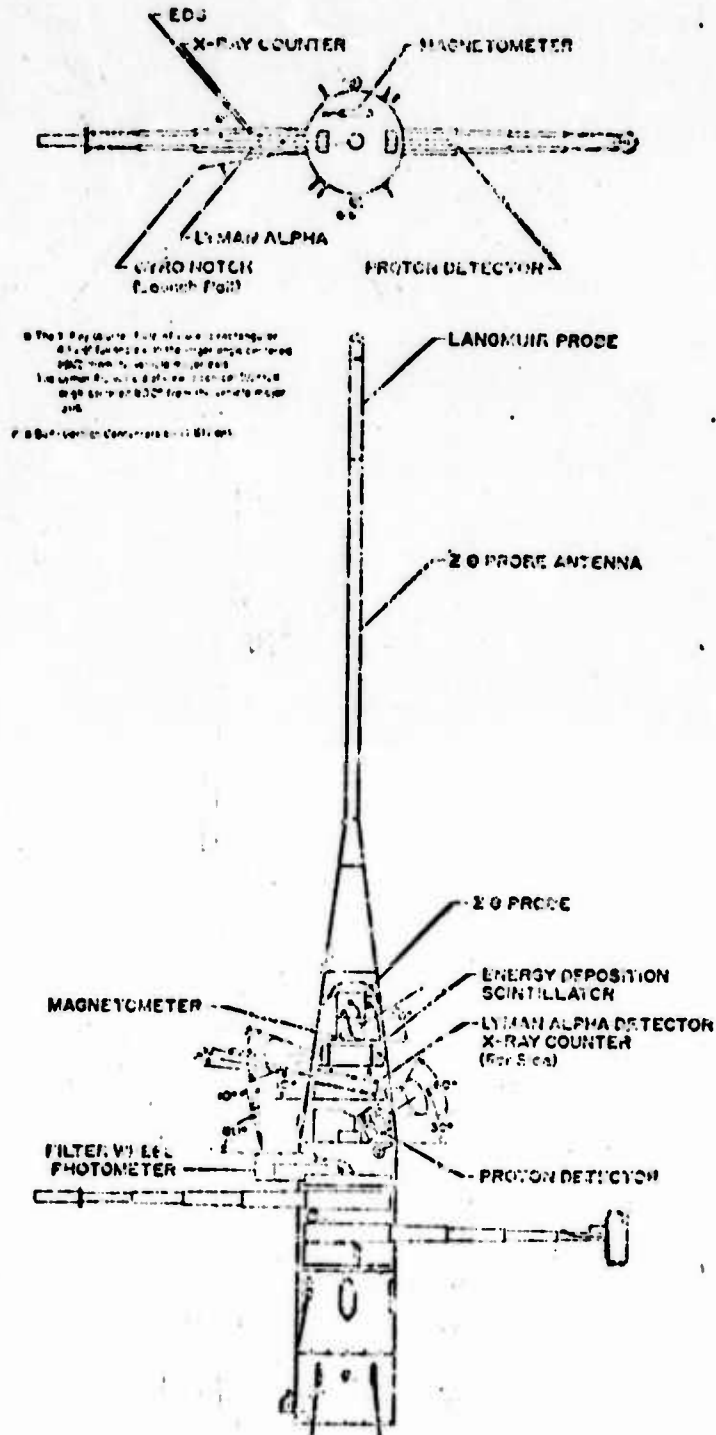
The following drawings illustrate the location and other physical data for each payload type.

IV. INSTRUMENTATION

A. Telemetry and Control

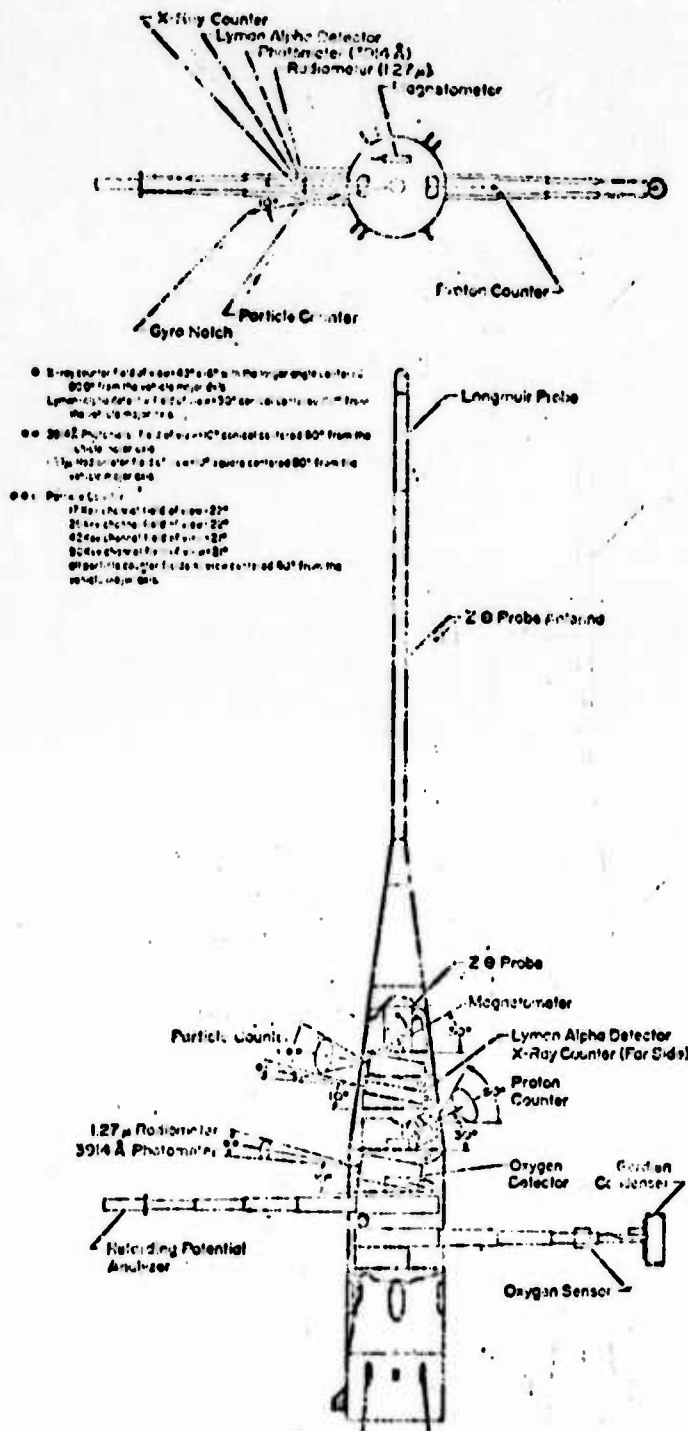
The telemetry system utilized was an FM/FM type consisting of two transmitters and VCO's as required to support the flight instrumentation for each payload type. Quadraloop antennas were mounted on the

A-TYPE PAYLOAD



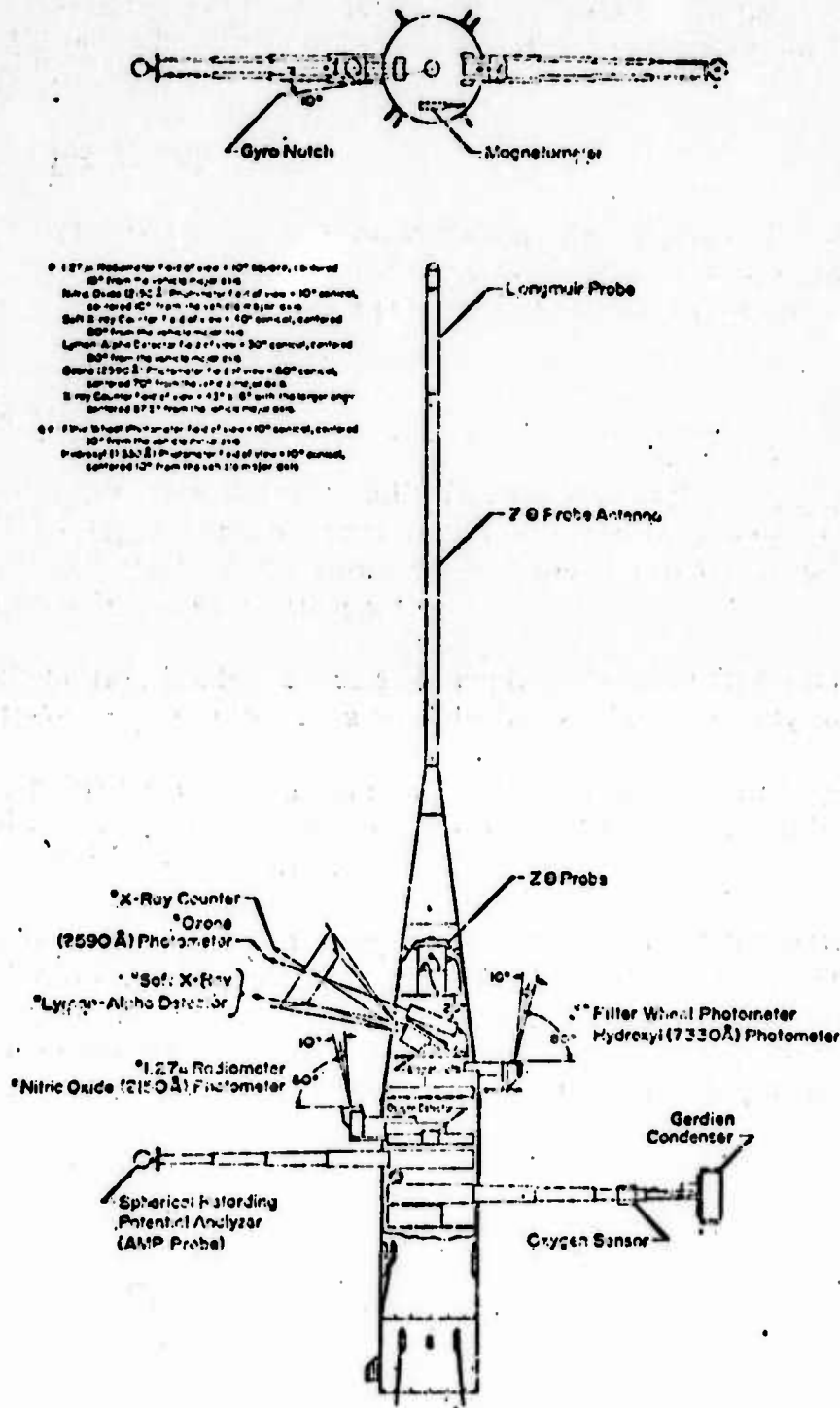
PCA-69 Black Brant Type "A" Payload In The Operating Configuration, Showing Instrument Look Angles And Fields Of View

B-TYPE PAYLOAD



PCA-60 Black Brant Type "B" Payload In The Operating Configuration, Showing Instrument Look Angles And Fields Of View

D-TYPE PAYLOAD



PCA-69 Black Brant Type "D" Payload In The Operating Configuration, Showing Instrument Look Angles And Fields Of View

telemetry section. All function monitors such as door eject monitors, drawer and boom deployment monitors as well as other housekeeping functions were commutated. The complete telemetry channel assignment and commutator segment allocation is given in the following pages.

Control of the instrumentation was accomplished by latching relays which enabled various sections of the payload to be operated independently on either internal or external power. Back up turn on was provided by "G" actuated switches.

B. Instrumentation

The scientific instrumentation varied slightly for each payload type. The exact content of each payload with serial number can be obtained from the following pages. Launch times and dates are also indicated.

V. SUMMARY

One payload was successfully fired a year prior to PCA 69. The results of this flight were so encouraging that the remaining five payloads were altered only slightly to accommodate lower latitude conditions and minor refinements of scientific goals.

A seventh payload was built to replace the one fired in 1968 so that six Black Brant payloads were available for PCA 69 as originally planned.

When a PCA did occur, six payloads were fired in accordance with the launch plan. Four launches were successful, one partially successful and one was considered a failure.

Never before in the history of scientific rocket investigation was a program of such magnitude as that of PCA 69 attempted. The cardinal reason for the high degree of program success was cooperation between the USAF personnel and the various contractors. We would like to thank everyone for their efforts and express our pride in being a part of PCA 69.

TELEMETRY FORMAT
MODEL "A" PAYLOAD - S/N 1, 2, 4 & 5

<u>Channel</u>	<u>Function</u>
T/M 1	
70.0 KHZ	Particle Detector (Para)
52.5	RPA Output (Adcole)
40.0	+ Ion Boom Gerdian (Adcole)
30.0	+ Ion Body Gerdian (Adcole)
22.0	- Ion Body Gerdian (Adcole)
14.5	Gyro Roll (CRL)
10.5	Gyro Pitch (CRL)
3.9	Gyro Yaw (CRL)
3.0	+ Sweep Mon (Adcole)
2.3	- Sweep Mon (Adcole)
1.7	RPA Sweep Mon (Adcole)
1.3	Magnetometer (CRL)
T/M 2	
70.0	Particle Detector (Para)
52.5	X-Ray Output (Utah)
40.0	Langmuir Probe (Utah)
30.0	Z θ Probe (Utah)
14.5	IPIG Commutator (CRL)
10.5	FW Radiometer (Utah)
3.9	Lyman Alpha (Utah)
3.0	EDS (Utah)
2.3	Langmuir Sweep (Utah)
1.7	Z θ Pot. Monitor (Utah)
1.3	Accelerometer (CRL)

COMMUTATOR ASSIGNMENT

<u>Segment #</u>	<u>Function</u>
1, 14 & 19	Zero Volts (Cal)
2 & 16	2.5 V (Cal)
3	EDS Temp (Utah)
4	EDS Hi E (Utah)
5	X-Ray Hi E (Utah)
6	Lyman Hi E (Utah)
7	Radiometer Temp (Utah)
8	Radiometer Hi E (Utah)
9	Particle Detector + 15 V Mon (Para)
10	Particle Detector - 15 V Mon (Para)
11	Particle Detector Hi E Mon (Para)
12 & 17	Beacon Mon
13 & 18	Inst. Battery #1 Mon.
15 & 20	Inst. Battery #2 Mon.
21	Door 1 Eject Mon
22	Door 2 Eject Mon
23	Door 3 Eject Mon
24	Door 4 Eject Mon
25	Radiometer Ext. Mon
26	Boom Motor Start Mon
27	Gerd Boom Ext. Mon
28	RPA Boom Ext. Mon

MODEL "B" PAYLOAD - S/N 3 & 6

T/M 1

70.0 KHZ
52.5 KHZ
40.0 KHZ
30.0 KHZ
14.5 KHZ
10.5 KHZ
3.9 KHZ
3.0 KHZ
2.3 KHZ
1.7 KHZ
1.3 KHZ

Particle Detector (Para)
RPA Output (Adcole)
+ Ion Boom Gerdian (Adcole)
Radiometer 127 (Utah)
Gyro Roll (CRL)
Gyro Pitch (CRL)
Gyro Yaw (CRL)
+ Sweep Mon (Adcole)
- Sweep Mon (Adcole)
RPA Sweep Mon (Adcole)
Magnetometer (CRL)

T/M 2

70.0 KHZ
52.5 KHZ
40.0 KHZ
30.0 KHZ
22.0 KHZ
14.5 KHZ
10.5 KHZ
3.9 KHZ
2.3 KHZ
1.7 KHZ
1.3 KHZ

Particle Detector (Para)
X-Ray Output (Utah)
Langmuir Probe (Utah)
Z Θ Probe (Utah)
Particle Counter (Utah)
IRIG Commutator (CRL)
Photometer 4000 (Utah)
Lyman Alpha (Utah)
Langmuir Sweep (Utah)
Z Θ Pot. Mon. (Utah)
Accelerometer (CRL)

COMMUTATOR ASSIGNMENTS

1 & 25	Zero Volts (Gnd)
2 & 16	+ 2.5 V
3	Particle Counter Temp (Utah)
4	Particle Counter Hi E (Utah)
5	X-Ray Hi E (Utah)
6	Lyman Alpha Hi E (Utah)
7	Photometer 4090 Temp (Utah)
8	Photometer 4090 Hi E (Utah)
9	Particle Detector + 15 V Mon (Para)
10	Particle Detector - 15 V Mon (Para)
11	Particle Detector - Hi E Mon (Para)
12	Beacon Mon (CRL)
13 & 18	Inst. Battery #1 Mon (CRL)
14	"O" Detector Sig #1 (Utah)
15 & 20	Inst. Battery #2 Mon (CRL)
17	Radiometer 127 Temp. (Utah)
19	"O" Detector Sig #2 (Utah)
21	Door 1 Eject (CRL)
22	Door 2 Eject (CRL)
23	Door 3 Eject (CRL)
24	Door 4 Eject (CRL)
26	Boom Motor Start Mon (CRL)
27	Gerdian Boom Ext. Mon (Adcole)
28	RPA Boom Ext. Mon (Adcole)

MODEL "D" PAYLOAD - S/N 7

T/M 1

70.0 KHZ	Zθ Probe (Utah)	0 - + 5V
52.5 KHZ	Standard X-Ray (Utah)	0 - + 5V
40.0 KHZ	Langmuir Probe (Utah)	+ 2.5V
30.0 KHZ	IRIG Commutator (CRL)	0 - + 5V
22.0 KHZ	Langmuir Sweep (Utah)	+ 2.5V
14.5 KHZ	Lyman Alpha (Utah)	0 - + 5V
10.5 KHZ	Soft X-Ray (Utah)	0 - + 5V
7.35 KHZ	Gyro Roll (CRL)	0 - + 5V
3.9 KHZ	Gyro Pitch (CRL)	0 - + 5V
3.0 KHZ	Gyro Yaw (CRL)	0 - + 5V
2.3 KHZ	Langmuir Ion (Utah)	0 - + 5V
1.7 KHZ	Magnetometer #1 (CRL)	0 - + 5V
1.3 KHZ	Magnetometer #2 (CRL/FHC)	0 - + 5V

T/M 2

70.0 KHZ	Amp Probe (Adcole)	0 - + 5V
52.5 KHZ	FW Photometer (Utah)	0 - + 5V
40.0 KHZ	Boom Gerdian (Adcole)	0 - + 5V
30.0 KHZ	OH Photometer (Utah)	0 - + 5V
22.0 KHZ	1.27 Radiometer (Utah)	0 - + 5V
14.5 KHZ	O ₃ Photometer (Utah)	0 - + 5V
10.5 KHZ	No Photometer (Utah)	0 - + 5V
7.35 KHZ	Gerdian Sweep (Adcole)	0 - + 5V
3.9 KHZ	Amp. Probe Sweep (Adcole)	0 - + 5V
3.0 KHZ	Accelerometer (CRL)	0 - + 5V
2.3 KHZ	"O" Detector (Utah)	0 - + 5V
1.7 KHZ	O ₃ Detector (Utah)	

COMMUTATOR ASSIGNMENT

1	0 Volt Calib
2	+ 2.5V Calib.
3	F.W. Photometer FW 4400 - Hi E
4	F.W. Photometer FW 4400 - Temp
5	Photometer 4400B-1 - Hi E
6	Photometer WT - 1D -
7	Photometer WT - 1D - Temp
8	Radiometer 127 - Temp
9	Photometer 4000B - Hi E
10	Photometer 4000B - Temp
11	Lyman Alpha - Hi E
12	STD X-Ray - Hi E
13	T _E (Adcole)
14	VATM (Adcole)
15	VOTM (Adcole)
16	-- 30 V Mon (Adcole)
17	
18	Battery #1 Mon
19	Battery #2 Mon.
20	Beacon Mon.
21	Door 1 Eject Mon
22	Door 2 Eject Mon
23	Door 3 Eject Mon
24	Door 4 Eject Mon
25	
26	Boom Motor Start
27	Gerd. Boom Ext. Mon
28	RPA Boom Ext. Mon

PAYLOAD #1 VEHICLE DESIGNATION - U-3 MODEL B
LAUNCH TIME 4 NOVEMBER 1969 - 2245:00 Z

Beacon Antennas	S/N 133, 140
T/M Antennas - 227.7	S/N V14, V15
T/M Antennas - 258.5	S/N V16, V17
T/M Transmitter - 22.7	S/N 339
T/M Transmitter - 258.5	S/N 335
Beacon -	S/N 870
Commutator	S/N 3
Accelerometer	S/N 62-509
Altitude Switch 20K'	S/N 379
Altitude Switch 20K'	S/N 376
Altitude Switch 75K'	S/N 385
T/M 1 VCO's	
70.0 KC	S/N
52.5 KC	S/N 4371-5
40.0 KC	S/N 5234-5
30.0 KC	S/N 5221-5
22.0 KC	S/N 4355-5
14.5 KC	S/N 5204-5
10.5 KC	S/N 5194-5
3.9 KC	S/N 5176-5
3.0 KC	S/N 4304-5
1.7 KC	S/N 5149-5
1.3 KC	S/N 5128-5
Mixer	S/N 3275
T/M 2 VCO's	
70.0 KC	S/N 4373-5
52.5 KC	S/N 5239-5
40.0 KC	S/N 6336-5
30.0 KC	S/N 5219-5
14.5 KC	S/N 5209-5
10.5 KC	S/N 5188-5
3.9 KC	S/N 4312-5
3.0 KC	S/N 4198-5
2.3 KC	S/N 5268-2
1.7 KC	S/N 5150-5
1.3 KC	S/N 5130-5
Mixer	S/N 3276
5 VDC Regulator	S/N 1381
Primary Timer	S/N 11878
Secondary Timer	S/N 11888
Gyro	S/N 68-1

Magnetic Aspect Sensor
Proton Detector
Adcole
ZEP Probe
Network Box
EDS
Lyman α Detector
X-Ray Counter
Multichannel Photometer
Langmuir Probe

S/N 2281
S/N P5
S/N 1
ZEP 68-2
ZEP 68-2
Model 4 Unit 8
L α 68-6
Model 5 Unit 5
BE-1 S/N 4
LP 68A-7A

**S/N 2 VEHICLE DESIGNATION -U-5 MODEL B
LAUNCH TIME: 3 NOVEMBER 1969 - 13:1500 Z**

Beacon Antenna	S/N 125, 129
T/M Antennas - 227.7	S/N W11, W12
T/M Antennas - 258.5	S/N W05, W06
T/M Trans. - 227.7	S/N 341
T/M Transmitter - 258.5	S/N 332
Beacon	S/N 868
Commutator	S/N 4
Accelerometer	S/N 38-655
Altitude Switch 20K'	S/N 373
Altitude Switch 20K'	S/N 375
Altitude Switch 75K'	S/N 382
T/M 1 VCO's	
70.0 KC	S/N 4243-5
52.5 KC	S/N 5241-5
40.0 KC	S/N 4366-5
14.5 KC	S/N 5199-5
10.5 KC	S/N 5191-5
3.9 KC	S/N 5175-5
3.0 KC	S/N 4306-5
1.7 KC	S/N 5142-5
1.3 KC	S/N 5133-5
Mixer	S/N 3282
T/M 2 VCO's	
70.0 KC	S/N 5254-5
52.5 KC	S/N 5243-5
40.0 KC	S/N 6338-5
30.0 KC	S/N 5227-5
14.5 KC	S/N 5203-5
10.5 KC	S/N 5187-5
3.9 KC	S/N 4313-5
3.0 KC	S/N 4305-5
2.3 KC	S/N 5269-2
1.7 KC	S/N 5147-5
1.3 KC	S/N 5133-5
Mixer	S/N 3281
5 VDC	S/N 1385
Gyro	S/N 64-2
Primary Timer	S/N 11884
Secondary Timer	S/N 11883

Magnetic Aspect Sensor
Proton Detector
Adeole
ZQ Probe
Network Box
EIS
Lyman α Detector
X-Ray Counter
Multichannel Photomer
Langmuir Probe

S/N 2279
S/N P3
S/N 5
ZQP 68-7
ZQP 68-8
Model 4 unit 5
L α 68-4
Model 5 S/N 2
BE-1 S/N 3
LP-68A-2A.

**S/N 3 VEHICLE DESIGNATION - U-1 MODEL B
LAUNCH TIME: 3 NOVEMBER 1969 - 0605:00 Z**

Beacon Antennas	S/N 123, 126
T/M Antennas 227.7	S/N W13, W14
T/M Antennas 258.5	S/N W01, W02
T/M Transmitter 227.7	S/N 340
T/M Transmitter 258.5	S/N 336
Beacon	S/N 864
Commutator	S/N 1
Accelerometer	S/N 93-586A
Altitude Switch 20K'	S/N 370
Altitude Switch 20K'	S/N 377
Altitude Switch 75K'	S/N 334
T/M 1 VCO's	
70.0 KC	S/N 5257-5
52.5 KC	S/N 4236-5
40.0 KC	S/N 4362-5
14.5 KC	S/N 5206-5
10.5 KC	S/N 5192-5
3.9 KC	S/N 4315-5
3.0 KC	S/N 4301-5
1.7 KC	S/N 4187-5
1.3 KC	S/N 5127-5
30.0 KC	S/N 5224-5
Mixer S/N 3284	S/N 3284
T/M 2 VCO's	
70.0 KC	S/N 5255-5
52.5 KC	S/N 4368-5
40.0 KC	S/N 5232-5
30.0 KC	S/N 5220-5
14.5 KC	S/N 5205-5
10.5 KC	S/N 5189-5
3.9 KC	S/N 5178-5
2.3 KC	S/N 5266-2
1.7 KC	S/N 4281-5
1.3 KC	S/N 5132-5
22.0 KC	S/N 5215-5
Mixer	S/N 3273
5 VDC Regulator	S/N 1383
Primary Timer	S/N 11879
Secondary Timer	S/N 11880
Gyro	S/N 64-3

Magnetic Aspect Sensor
 Proton Detector
 Adcole
 ZEP Probe
 Network Box
 Particle Counter
 Lyman α Detector
 X-Ray Counter
 Langmuir Probe
 3910 Photometer
 Model 127 Radiometer
 Atomic "O" Detector
 Atomic "O" Sensor
 Radiometer WW-6

S/N 2282
 S/N PG
 S/N 3
 ZEP 68-6
 ZEP 68-6
 PC-69-5
 L α 68-7
 Model 5 S/N 4
 LP 68A-3A
 WT 4 S/N 4
 S/N 001
 S/N 4
 S/N 2
 S/N 1

S/N 4 VEHICLE DESIGNATION - U-2 MODEL A
LAUNCH TIME: 2 NOVEMBER 1969 - 2019:59 Z

Beacon Antennas	S/N 131, 139
T/M Antennas - 227.7	S/N W9, W10
T/M Antennas 258.5	S/N W07, W08
T/M Transmitter - 227.7	S/N 342
T/M Transmitter 258.5	S/N 334
Beacon	S/N 867
Commutator	S/N 2
Accelerometer	S/N 63-584A
Altitude Switch 20K'	S/N 369
Altitude Switch 20K'	S/N 368
Altitude Switch 75K'	S/N 386
T/M 1 VCO's	
70.0 KC	S/N 4241-5
52.5 KC	S/N 5240-5
40.0 KC	S/N 4363-5
14.5 KC	S/N 5207-5
10.5 KC	S/N 4339-5
3.9 KC	S/N 4201-5
3.0 KC	S/N 5160-5
1.7 KC	S/N 5140-5
1.3 KC	S/N 4273-5
Mixer	S/N 3274
T/M 2 VCO's	
70.0 KC	S/N 5252-5
52.5 KC	S/N 4237-5
40.0 KC	S/N 6339-5
30.0 KC	S/N 4361-5
14.5 KC	S/N 5208-5
10.5 KC	S/N 4341-5
3.9 KC	S/N 4204-5
3.0 KC	S/N 5161-5
2.3 KC	S/N 5267-2
1.7 KC	S/N 5146-5
1.3 KC	S/N 5137-5
Mixer	S/N 3279
5 VDC Regulator	S/N 1384
Gyro	S/N 63-1
Primary Timer	S/N 13018
Secondary Timer	S/N 11839

Magnetic Aspect Sensor.

Proton Detector

Adcele

Z Θ Probe

Network Box

EDS

Lyman α Detector

X-Ray Counter

Multichannel Photometer

Langmuir Probe

S/N 2284

S/N P6

S/N 4

Z Θ P 68-4

Z Θ P 68-4

Model 4 Unit 6

L α 68-1

Model 5 Unit 3

BE-1 S/N 5

LP 68A-4A

S/N 5 LAUNCH DATE 19 NOVEMBER 1968 - MODEL A

Swip Matching Network	UARI 68 Unit 1
ZO Probe	UARI 68 Unit 5
EDS	Model 4 Unit 2
X-Ray Counter	UARI 5 Unit 1
Magnetometer	S/N 2282
Lyman	UARI 68 Unit 4
DC TODC Conv.	Model DC 250 S/N 5
DC TODC Conv.	Model DC 15 S/N 8
P.C. Box	S/N 8
Proton Detector	S/N 8
Programmer	S/N 102 (Adcole All S/N 2)
Antenna Range	

T/M 1		T/M 2
1.3 KHZ	S/N 5129-5	S/N 5131-5
3.9 KHZ	S/N 4310-5	S/N 5174-5
3.0 KHZ	S/N 4193-5	S/N 4300-5
2.3 KHZ	S/N 4289-5	S/N 4201-2
1.7 KHZ	S/N 5141-5	S/N 5144-5
22.0 KHZ	S/N 4352-5	N/A
14.5 KHZ	S/N 5202-5	S/N 5211-5
10.5 KHZ	S/N 5193-5	S/N 4344-5
70.0 KHZ	S/N 5374-5	S/N 5253-5
52.5 KHZ	5239-5	S/N 5242-5
40.0 KHZ	S/N 5235-5	S/N 5277-2
30.0 KHZ	S/N 5228-5	S/N 5222-5
Mixer	S/N 3280	S/N 3277
Regulator	N/A	S/N 1387
Transmitter - 227.7	S/N 344	2258.5 S/N 333
Commutator	S/N 8	
Receiver		
Accelerometer	S/N 32-002	
Altitude Switch 20K'	S/N 367	
Altitude Switch 20K'	S/N 374	
Altitude Switch 75K'	S/N	
Gyro	S/N 68-2 Removed from T/M section	
"G" Time	S/N 11-886	S/N 11-885
"G" Switch	S/N 148	S/N 145

S/N 6 VEHICLE DESIGNATION - U-6 MODEL B
LAUNCH TIME: 4 NOVEMBER 1969 - 2308:00 Z

Beacon Antennas	S/N 121, 132
T/M Antennas - 227.7	S/N W15, W16
T/M Antennas 258.5	S/N W03, W04
T/M Transmitter - 227.7	S/N 343
T/M Transmitter - 258.5	S/N 337
Beacon	S/N 863
Commutator	S/N 5
Accelerometer	S/N 93-604A
Altitude Switch 20K'	S/N 372
Altitude Switch 20K'	S/N 371
Altitude Switch 75K'	S/N 383
T/M 1 VCO's	
70.0 KC	S/N 4240-5
52.5 KC	S/N 4370-5
40.0 KC	S/N 5233-5
14.5 KC	S/N 5211-5
10.5 KC	S/N 4338-5
3.9 KC	S/N 5173-5
3.0 KC	S/N 4196-5
1.7 KC	S/N 5143-5
1.3 KC	S/N 5136-5
30.0 KC	S/N 5223-5
Mixer	S/N 3283
T/M 2 VCO's	
70.0 KC	S/N 4242-5
52.5 KC	S/N 4238-5
40.0 KC	S/N 5599-5
30.0 KC	S/N 5226-5
14.5 KC	S/N 5201-5
10.5 KC	S/N 5166-5
3.9 KC	S/N 5179-5
2.3 KC	S/N 5270-2
1.7 KC	S/N 5148-5
1.3 KC	S/N 5134-5
22.0 KC	S/N 5214-5
Mixer	S/N 3278
5 VDC Regulator	S/N 1386
Primary Timer	S/N 11981
Secondary Timer	S/N 11890
Gyro	S/N 65-214

Magnetic Aspect Sensor.
 Proton Detector
 Adcole
 Z Θ Probe
 Z Θ Network
 Particle Counter
 Lyman α Detector
 X-Ray Counter
 3910 Photometer
 Model 127 Radiometer
 Atomic "O" Detector
 Atomic "O" Sensor
 Langmuir Probe

S/N 2273
 S/N P4
 S/N 6
 Z Θ P 68-3
 Z Θ P 68-3
 PC 69-6
 L α 68-2
 PR 2-1
 WT 4-8
 S/N 002
 S/N 5
 S/N 1
 LP 68A-6A

S/N 7 VEHICLE DESIGNATION - U-4 MODEL D
LAUNCH TIME: 3 NOVEMBER 1969 - 1711:00 Z

Beacon Antennas	142, 124
T/M Antennas - 227.7	AA12, AA11
T/M Antennas - 258.5	AA13, AA14
T/M Transmitter - 227.7	338
T/M Transmitter - 258.5	331
Beacon	582
Commutator	7
Accelerometer	112831
Altitude Switch 20K'	376
Altitude Switch 20K'	394
Altitude Switch 75K'	381
T/M 1 VCO's	
70.0 KC	5258-5
52.5 KC	4369-5
40.0 KC	6335-5
30.0 KC	5584-5
22.0 KC	6334-5
14.5 KC	5553-5
10.5 KC	5541-5
7.35 KC	4180 (Dorsett)
3.9 KC	6328-5
3.0 KC	5475-5
2.3 KC	4288-5
1.7 KC	5440-5
1.3 KC	5135-5
Mixer	3399
Regulator	1412
T/M 2 VCO's	
70.0 KC	4372-5
52.5 KC	4367-5
40.0 KC	6337-5
30.0 KC	5225-5
22.0 KC	5213-5
14.5 KC	5552-5
10.5 KC	5190-5
7.35 KC	4203 (Dorsett)
3.9 KC	5177-5
3.0	4299-5
2.3 KC	4190-5
1.7 KC	5145-5
Mixer	3272
Timer (Pri)	13019
Timer (Sec)	13017
Gyro	17-22
"G" Switch	137
"G" Switch	150

Magnetometer

Adcole

ZØ Probe

ZØ Network Box

Soft X-Ray & Lyman α

UV-Photometer

Radiometer

X-Ray Counter

"O" Detector

"O" Sensor

Langmuir Probe

Photometer (FW)

Photometer

ZØP 68-1

ZØP 68-5

69-1

WTI-B S/N 1

127B S/N 001

Model 5 S/N 8

S/N 1

S/N 4

LP 68A - 8A

FW 4400 S/N 001

4000-B None

BLACK BRANT V

Schematic Diagram TM & Control	TSD-500-300-0001 (R)
Schematic Diagram - Instrumentation Section	-0002 (R)
Schematic Diagram - GSE Panel	-0003 (R)
Cabling Schematic	-0004 (B)
GSE to Blockhouse TB Wire List	-0005 (B)
Launcher to Payload Wire List	-0006 (B)
GSE to Payload Test Cable	-0007 (B)
GSE Panel Machined	-0008 (D)
Relay Mounting Bracket - GSE	-0009 (D)
Wire List and Cable Diagram	-0010 (D)
Battery Box	-0011 (D)
Cover - Battery Box	-0012 (D)
Doubler Plate	-0013 (D)
Telemetry Access Door	-0014 (D)
Mounting Plate	-0015 (D)
Cover - Gyro	-0016 (D)
Mounting Plate - Connector	-0017 (B)
VCO Housing No. 2	-0018 (C)
VCO Housing No. 1	-0019 (C)
Bracket - (G) Timer Mounting	-0020 (C)
Adapter Plate - Mounting (G) Timer	-0021 (C)
Plate - Cover VCO Housing No. 2	-0022 (C)
Plate - Cover VCO Housing No. 1	-0023 (C)
Door - Igniter Access	-0024 (C)
Igniter Housing	-0025 (R)
Mounting Plate Telemetry	-0026 (D)
Grounding Plate	-0027 (C)
Grounding Switch Assembly	-0028 (C)
Mounting Block - Fly Away Connector	-0029 (D)
Mounting Bracket - G Switch	-0030 (D)
Standoff - Relay Rack	-0031 (C)
Connector Plate - VCO No. 1	-0032 (C)
Connector Plate - VCO No. 2	-0033 (C)
Standoff - Mounting Plate - Gyro	-0034 (B)
Standoff - VCO	-0035 (B)
Pad - Battery	-0036 (B)
Pad - Battery	-0037 (C)
Housing - Telemetry	-0038 (J)
Spacer - Commutator	-0039 (B)
Spacer Plates - Battery Box	-0040 (C)
ETS Connector Mounting Plate	-0041 (B)
VCO Housing - Modified	-0042 (C)
Connector Plate - VCO Housing Modified	-0043 (C)
Cover Plate - VCO Housing Modified	-0044 (C)
Clip Angle - Deck Attach Stn. 48,000 Upper	-0045 (B)
Bushing Block - Extending Gerdian	-0046 (D)

BLACK BRANT V (CONTINUED)

Bushing Cap - Extending Gerdian	TSD-500-300-0047 (C)
Rod - Extending Gerdian	-0048 (C)
Bushing Block Assembly - Extending Gerdian	-2049 (C)
Mounting Bracket - X-Ray Counter Sub-Assembly	-2050 (D)
Deck Plate No. 1 - Station 25,500	-0051 (D)
Deck Plate No. 2 - Station 41,100	-0052 (D)
Deck Plate No. 3 - Station 48,000	-0053 (D)
Deck Plate No. 4 - Station 55,750	-0054 (D)
Deck Plate No. 5 - Station 61,500	-0055 (D)
Deck Plate No. 6 - Station 66,000	-0056 (D)
Mounting Bracket - E.D.S. Experiment	-0057 (D)
Mounting Bracket RPA Boom Monitor	-0058 (C)
Mounting Block - Ram 5C Magnetometer	-0059 (C)
Connecting Pin - RPA - Detector	-0060 (B)
Rod End Plate - RPA Detector	-0061 (B)
Adaptor Plate - RPA Detector	-0062 (C)
Extension Rod - RPA Detector	-0063 (C)
Web Plate - RPA Slide	-0064 (C)
Web Plate - Extending Gerdian Slide	-0065 (C)
Mounting Bracket - RPA Amplifier	-0066 (C)
Slide Fastener Plate - Extending Gerdian	-0067 (D)
Slide Fastener Plate - RPA Detector	-0068 (D)
Mounting Bracket - Extending Gerdian Boom Monitor	-0069 (C)
Pulley - RPA Boom Monitor Cable 1-31-68 Voided	-0070 (B)
Shaft - RPA Boom Monitor Cable	-0071 (B)
Cable Fitting - Extended Gerdian	-0073 (B)
Mounting Plate - Electrometer Gerdian AMF Ext	-0074 (C)
Mounting Bracket Sub-Assembly Proton Detector	-2075 (D)
Rod End Plate Extending Gerdian	-0076 (B)
Bushing Cap RPA Detector	-0077 (C)
Bushing Block RPA Detector	-0078 (D)
Bushing Block Assembly RPA Detector Extending Slide	-2079 (C)
Frame Subassembly - Assy. Sta. 41,000 Radiometer Slide	-2080 (E)
RH & LH MTG. Angle - Assy. Sta. 41,100 Radiometer Slide	-0081 (C)
Attach Angle - Slide Brace - Sta. 25,500	-0082 (C)
Attach Angle - Slide Brace - Sta. 41,100	-0083 (C)
LH Slide Brace Plate	-0084 (D)
RH Slide Brace Plate	-0085 (D)
Deck Attach Angle - R & L Hand Sta. 56,000 & 61,500	-0086 (C)
Deck Attach Angle - R & L Hand Sta. 66,000	-0087 (B)
Spacer - Relay Rack	-0088 (C)
Angle Bracket - Relay Connector	-0089 (C)
Primary Angle - Relay Rack	-0090 (D)
Secondary Angle - Relay Rack	-0091 (D)
Relay Rack Assembly	-2092 (J)
Deck Attach Angle Stns. 4800 lower 41,000 and 25,5	-0093 (B)

BLACK BRANT V (CONTINUED)

Splice Plate - Station 48,000	TSD-500-300-0094 (B)
Spring Guide - Door Ejector Model B	-0095 (B)
Detent - Ball Model B	-0096 (B)
Block Spacer Door Ejector Model B	-0097 (C)
Plate Door Ejector Model B	-0098 (C)
Attachment Plate - Door Ejector Model A	-0099 (C)
Attachment Plate - Door Ejector Model B	-0100 (C)
Plate - Door Ejector Model A	-0101 (C)
Mounting & Spring Housing Block Model A & B	-0102 (B)
Spring Guide - Door Ejector Model A	-0103 (B)
Block Spacer - Door Ejector Model A	-0104 (B)
Subassembly Model A - Used on sta. 41,000, 55,150 & 65,000	-2105 (D)
Deck Support Channel-1 sta. 25,500 to 48,000 -2 sta. 48,000 to 66,000	-0106 (D)
Squib Fire Circuit	-0107 (B)
Shoulder Screw - RPA Detector	-0108 (B)
Stop Pin - Radiometer Slide	-0109 (B)
Mounting Plate - Micro Switch	-0111 (B)
Detent Ball - Model "A" Door Ejector	-0112 (B)
Grounding Strip - Release Mechanism	-0113 (B)
Control Circuit	-0114 (B)
Retainer - Ball	-0115 (C)
Sub-Assembly Model B used at sta. 48,000 Door Release Mech.	-2116 (D)
Stop Spring - Subassembly	-2117 (B)
Strip - Pullaway - Door Ejector Model A	-0018 (B)
Assembly Black Brant VA Inst. Payload	-1119 (J)
Assembly Black Brant Telemetry	-2120 (J)
Pulley Bracket - RPA Boom Monitor Cable	-0121 (B)
Spacer - Connector VCO	-0122 (B)
Door No. 1 - Station 66,000	-0123 (D)
Mounting Plate, Altitude Switch	-0124 (C)
Door No. 2 - Station 55,750	-0125 (D)
Door No. 4 - Station 27,700 to 41,700	-0126 (D)
Door No. 3 - Station 35,720 to 47,400	-0127 (D)
Door No. 4 Doubler - Station 27,700 to 55,750	-0128 (D)
Door No. 3 Doubler - Station 35,720 to 47,400	-0129 (D)
Door No. 1 Doubler - Station 66,000	-0130 (D)
Door No. 2 Doubler Station 55,750	-0131 (D)
VCO Blank - VCO Housing	-0132 (C)
Spool Shaft - Gear Box	-0133 (B)
Idler Shaft - Gear Box	-0134 (B)
Motor Shaft - Gear Box	-0135 (B)
Battery Box Blank	-0136 (B)
Housing - Gear Box	-0137 (E)
Solenoid Plunger - Gear Box	-0138 (B)
Solenoid Bracket - Gear Box	-0139 (B)
Worm Shaft Assembly (Worm Shaft Hub)	-0140 (B)

BLACK BRANT V (CONTINUED)

Worm Shaft - Gear Box	TSD-500-300-0141 (B)
Worm Shaft Assembly - Gear Box	-3142 (B)
Modification Worm Gear 20 Teeth	-0143 (B)
Modification Spur Gear 12 Teeth	-0144 (B)
Modification Spur Gear 48 Teeth	-0145 (B)
Modification Spur Gear 20 Teeth	-0146 (B)
Test Fixture - Spinning	301-0147 (D)
Spacer - Gear Box	-0148 (B)
Spacer - Worm Shaft - Gear Box	-0149 (B)
Test Fixture - Vibration	301-0150 (D)
Channel Plate - Cable Stowage RPA	-0151 (C)
Bushing Guide - Cable Stowage RPA	-0152 (C)
Flanged Bushing - Cable Stowage RPA	-0153 (C)
Support Strap - Cable Stowage - Gerdian	-0154 (C)
Baffle Plate - Cable Stowage - Gerdian	-0155 (C)
Holddown Finger - Ejectable Door	-0156 (C)
Gear Box Assembly	-2157 (E)
Assembly Fixture	301-2158 (J)
Bracket - (G) Timer Mounting	300-2159 (C)
Plate - Gerdian	-0160 (C)
Cable Attach Fitting - Extended Gerdian	-0161 (C)
Cable Fitting - RPA Plate	-0162 (C)
Plunger - Stop Block	-0163 (C)
Pad - Brake	-0164 (C)
Special Brake Pressure Bolt	-0165 (C)
Brake Shoe	-0166 (C)
Pressure Shims	-0167 (C)
Pressure Shim	-0168 (C)
Swage Tool	500-301-0169 (C)
Bracket - Switch	-0170 (C)
Rod - Switch Actuator	-0171 (C)
Plate - Retainer	-0172 (C)
Amplifier Bracket	-0173 (C)
Snubbing Block	-0174 (C)
Pin, Cable Restraining	-0175 (C)
Pin, RPA, Restraining	-0176 (C)
Plunger, Stop Block	-0177 (C)